University of Delaware
Disaster Research Center

PRELIMINARY PAPER
#179

FUTURE DISASTERS AND PLANNING FOR THEM: THE EFFECTS OF CURRENT SOCIAL CHANGE TRENDS*

E. L. Quarantelli

1992

*This is a more extended written version of the oral remarks made at the Sociology of Disaster session at the German Sociological Association meeting in Dusseldorf, Germany on September 30, 1992. While a few quotations are referenced and a few general references are provided, other relevant specific references and a bibliography covering the substantive content of this paper can be found in E. L. Quarantelli, More and worse disasters in the future: The social factors involved, Preliminary Paper #173, Newark, DE: Disaster Research Center, University of Delaware, 1991; see also, E. L. Quarantelli, "Urban vulnerability and technological hazards in developing societies." Pp. 187-236 in Alcira Kreimer and Mohan Munasinghe (eds.) Environmental Management and Urban Vulnerability. Washington, DC: The World Bank, 1992.

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Abstract

On the global scene, but particularly in modern societies, we are inevitably faced with more and worse disasters in the future. Irrespective of whether the agents involved be natural or technological, there will be both quantative and qualitative increases in the negative direction. This will result from two current social trends---industrialization and urbanization---inherent in the very dynamics of modern social life. The first trend almost insures that disaster agents and occasions will increase. The second trend is raising the risks and vulnerabilities of impacted populations and societies. The social changes going on will also contribute positively to disaster planning, but on balance unless a greater effort is made, it can be anticipated that future disasters will be more of a problem in the future than they have been in the past.

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Current Social Trends

The 21st Century is only a few years off. But it is safe to say that its social landscape and features will be rather different from that in which we have lived in the 20th Century. What is in place now and was in being in recent past decades will be rather different in coming years.

Massive social changes of all kinds are happening in the political, economic, familial, cultural, educational and scientific areas. These are not only occurring in the developing nations of the world and in Eastern Europe too in the wake of the collapse of the Soviet Union, but also in the developed societies, found mostly in Western Europe as well as in Canada, the United States, Australia and a few others countries elsewhere. The most important structures and activities of human life are drastically changing. This can be seen in many ways. As examples we can mention the new family and household patterns that are emerging, the basic alterations occurring in the role and status of women, the move almost everywhere to a market type economy to produce goods and distribute services, the spread of at least formal democratic patterns of government, the growing dominance of non-traditional artistic and musical forms as well as a globalization of popular culture, the escalating use of computers and related means for training and educating people, or the growing diffusion and expanding use of applied social science to many areas of life.

If existing trends continue, the societies of the 21st Century will mostly have cultural values and beliefs which will primarily emphasize productivity of goods, economic growth, national wealth and international competiveness. This orientation is based on improving technology, especially in its machine aspects, and its application in all spheres: agricultural, industrial and informational. The continuing drive towards technological growth and application means an acceleration of long standing trends towards structural differentiation and complexity which are mostly to be handled by bureaucratic organizations, increasingly centered in urban localities. This is also accompanied by increasing pressure towards democratization which includes a drive for the rights of citizenship, inclusion and participation in the polity, equality, justice, and adequate welfare provisions. Many of these tendencies are spearheaded by their presentation in ever more global mass communication systems that are constantly expanding their abilities to expose their contents to world wide audiences through a variety of advanced electronic and high tech means (for further discussions of future trends, see Smelser, 1991).

All of these changes around the world will affect the appearance, characteristics and dynamics of disasters, and the planning and managing of disasters everywhere. However, we initially want to single out two of these social trends because they particularly

will influence the numbers and kinds of disasters that will occur. In the last part of the paper, we will note two other trends that are and will positively influence disaster planning and managing.

Among the major social changes we first want to note are two which are not totally new trends, but which are both massive in their social consequences and accelerating in their recent manifestations. They are the ever increasing industrialization of the world as well as the quickening of the urbanization process. Industry with its accompanying new kinds of technology is spreading everywhere. For example, while in 1888 the five most highly industrialized societies were responsible for 83% of the world's industrial production, a century later the output of the top five was only 57% reflecting the continuing diffusion of industrial technology throughout the world (Lenski, Lenski and Nolan, 1991). This trend has been paralleled by an ever swelling involvement of populations in an urban way of life concentrated in constantly enlarging metropolitan areas. Thus by the year 2010, there will be 511 cities exceeding a million inhabitants each and for the first time the world population will be predominantly urban, 51.8%; 15 years later, there will be 639 metropolises of over a million persons (Jones, 1992).

Now these two related trends or processes of industrialization and of urbanization have consequences for disasters. They insure that we will have both more and worst disasters. Built into the very dynamics of social life as they are, industrialization and urbanization will of necessity quantatively increase and qualitatively worsen the disasters of the 21st Century.

In the next section of the paper we want to illustrate and explain why this will happen. The evidence and data base we use do not come from any specific study. Instead they are derived from the corpus of the social science literature on disasters (for summaries see Drabek, 1986; Drabek and Hoetmer, 1991; Kreps, 1985, 1981), as well as general sociological analyses of social change and trends (e.g., Bell, 1973; Lenski, 1991; Perrow, 1991; Smelser, 1991).

Since we are looking for disaster-related consequences associated with continuing and increasing industrialization and urbanization in the world, this paper will discuss mostly the negative and problematical aspects of the two processes. This of necessity ignores the more positive features that are also the consequences of an industrial technology and an urban way of life. It could be easily argued that if on balance there were not more favorable or positive effects than unfavorable or negative ones, the processes would eventually come to a halt, if not reversed. This should be kept in mind in reading what follows.

In the main, we will be talking about disasters, those crisis occasions generated by the threat of or the actual impact of relatively sudden natural and technological disaster agents (such

as earthquakes, toxic chemical spills, floods, radiation fallouts, hurricanes, forest and brush fires, landslides, transportation wrecks and crashes, volcanic eruptions, structural failures, tornadoes, explosions, avalanches, etc.). To a lesser extent our comments are also applicable to more slow moving and/or very diffuse agents such as are involved in social occasions like famines, droughts, epidemics, toxic poisonings through hazardous wastes, radiation contaminations through radon gas, many air and water pollution episodes, etc. Given space limitations we leave aside discussing the applicability of our observations for other even more different kinds of crises, especially the ones involving social conflicts such as in civil strife, revolutions, riots, terrorist attacks, acts of sabotage, product tampering, etc., although we believe that these too will increase in the future.

Increases in Disaster Agents and Occasions

1. There are new and escalating kinds of technological accidents and mishaps that were almost non-existent prior to World War II and that will increasingly result in disasters.

To the risk of so-called natural hazards the human race has been adding at an accelerating rate a relatively newer risk, those stemming from technological accidents and mishaps. The latter happenings increasingly contribute to the appearance of disaster occasions. We are faced with ever more disasters in the technological area resulting from human errors and collective mistakes of groups. To the "Acts of God", we have been adding at any escalating rate the "Acts of Men and Women" or "Society".

Technological hazards are a relatively new class of danger which contemporary society is only just beginning to recognize. Disaster wrought by the unintended consequences of technology has largely been a product of the large-scale development of industry initiated by the 18th century industrial revolution in Europe. Mishaps associated with technology have occurred since the first tool was developed by a human. However, the scale of consequences, in terms of social disruption and the endangering of the social infrastructure, only reached significant proportions with the development of large industrial complexes to mass produce myriad goods (for examples of this from Australian society see Britton, 1991). But what has come into being in developed societies is rapidly occurring now also in developing social systems.

This and the activities associated with industrialization--the discovery and invention of new energy sources together with large-scale production and storage requirements; the creation of complex transportation modes, haulage routes and depots; the need for disposal of unwanted wastes; increasing amounts and dangers from atmospheric pollutants; the development of mass transit modes, networks and stations--have produced conditions which jeopardize public safety and enlarge community vulnerability. Because of

this, the increase in industrialization will increasingly create greater risks and eventual disasters.

The major technological threats are currently in the chemical and the nuclear area. The manufacture, processing, transportation or distribution, storage, and the application or use of many products of these two areas are inherently hazardous. They almost insure quantatively more and qualitative worse future disasters.

a. The chemical area.

Chemicals have truly transformed the world and modern societies are impossible without them; their use reflects a widespread desire to have higher standards of living and particular lifestyles which otherwise could not be achieved. The technology of chemistry has been consciously cultivated and applied because of the perceived and actual benefits involved. This is true not only in developed but also developing societies, as indicated by the fact that in a country like India the chemical industry has become a 20 billion dollar a year industry that accounts for 10% of the gross national product and 40% of the nation's gross industrial output (Ramasubramanian, Mitra and Bandopadhyay, 1987: 180).

But as Bhopal showed, there are multiple risks associated with the production, transportation, storage and use of dangerous chemicals for there are multiple ways in which human and other organisms, plant life and fauna, and physical material objects can be destroyed, damaged or directly negatively affected by a dangerous chemical. A chemical emergency or disaster can involve many perilous happenings unlike the typical earthquake or volcanic eruption. The referents of the term "chemical hazard" are many.

Even localities which in the past had none or few risks from natural disaster agents, are <u>now</u> vulnerable if they have any roads, railways or navigable waterways in the vicinity of toxic chemical spills, explosions, or fires. In a sense, the creation of major transportation infrastructures has reduced the geographic selectivity of possible disaster impacts. Almost all inhabited areas have now become vulnerable to disasters from hazardous chemicals even though there be no manufacturing, storage or use facilities in the vicinity. Not all societies or communities within them are subject to major natural hazard threats; but now almost all are at risk as they are increasingly subject to dangerous chemicals are more and more moved around.

Furthermore, the threat of greater disasters of this kind is spiraling because of the greater amounts of dangerous material involved. For instance, from 1960 to 1980, not only has the number of seagoing tankers carrying petrochemicals doubled, but their shipping tonnage has expanded sevenfold! Economic considerations are leading to the use of ever larger tankers. So increasingly, there is something bigger to spill, explode or burn on waterways as

illustrated by the Amoco-Cadiz oil spill off the French coast and even more dramatically the Exxon Valdez oil spill off Alaska.

In addition, to the in-plant and transportation kinds of acute chemical types of disasters, we have also been adding the more slowly developing and diffuse types associated with hazardous waste sites. Love Canal and Times Beach in the United States as well as Seveso in Italy are examples of what we may expect more in the future. In fact, the Seveso Directive issued in 1982 by the Council of European Communities accepts the probability of such future disasters by attempting to set as legal policy the idea that citizens must be adequately informed of the nature of and extent of existing hazards, the planning measures being undertaken, and what might be expected of a disastrous occasion.

b. The nuclear area.

Another increasing source of danger is the nuclear power industry. It has less than a half century existence. But it was developed because it initially seemed to offer a relatively dependable and relatively inexpensive source of energy especially for industrial expansion, compared with other energy sources such as oil which was seen as eventually depletable and increasingly costly to obtain. A move in the direction followed made much economic sense.

However, the risks associated with nuclear power has been illustrated, first by Three Mile Island, then Chernobyl. We may expect more along those lines given that there are over 435 commercial nuclear plants in existence at present, and about 100 more under construction. It should be noted that such a happening could pale the negative effects and consequences of Chernobyl, which contrary to much popular and even official thinking was far from a worst case scenario.

Apart from in-plant nuclear plant problems there are the risks associated with the transport of nuclear wastes over long distances. In the United States alone, by the year 2000, there will be about 47,900 metric tons of spent fuel, compared to 12,900 tones in 1985, to be shipped to some deposit somewhere. In addition, in the long run any society that presently has nuclear plants will be faced with the problems stemming from their necessary and eventual shutting down (and for some countries there is the added problem of the decommissioning of nuclear submarines). The large volumes of radioactive wastes resulting from the dismantling of such nuclear facilities will pose problems of disposal. The material is going to have to be transported from many places to some chosen sites, and naturally that raises the probability of some accident in all countries involved in such transportation (this is complicated by the fact that some nations, including European ones, ship their nuclear waste overseas).

2. There are technological advances that reduce some hazards but add complexity to old threats.

Of course modern technology can be used to try to eliminate or reduce some risks. The medical health area is marked by any number of such successful efforts. Unfortunately, sometime positive consequences from technological applications are accompanied by negative effects. There are two aspects to this: (1) preventive or protective measures which indirectly lead to other kinds of possible disastrous occasions, and, (2) the scale of chain reactions possible in modern societies which as a result of network linkages can turn a minor emergency into a major disaster.

An example of the first is fires in high rise buildings. In combination with the highly combustible and toxic construction and furnishing materials presently used, they have brought an additional threat dimension to that kind of situation. We prevent buildings from being burned by raising the probability of their inhabitants being asphyxiated. Even plane crashes are interesting along this line. Research has generally shown that the ensuing fires kill more passengers than the crash itself. Eighty percent of those that do die from the fire actually succumb to the gas and smoke from the lightweight burning cabin material! It makes a plane safer along certain lines if less heavy material is used; however for economic reasons such material is seldom fire proof.

Technology sometimes is used in efforts to improve safety and reduce the possibilities of accidents and mishaps. This is a laudable effort but not necessarily always achieved. This can partly be seen in the following quotation from Lee Thomas, a one time head of the US Environmental Protection Agency. He said:

> It is entirely possible that somewhere in the country toxic metals are being removed from the air, transferred to a waste water stream, removed again by water pollution controls, converted to a sludge, shipped to an incinerator and returned to the air.
> (New York Times, May 11, 1986).

He is pointing to the fact that many technologies that reduce or prevent the development of certain kinds of risk or environmental threats do so by solutions that can generate their own dangers.

As another example, in meeting the Clean Water Act of 1972 in the United States, the waste water treatment of sewage can lead to the production of sludge which will contain viruses, toxic substances and heavy metal (see Williams, 1991: 73). The sludge can be treated, but this will frequently produce methane gas and carbon dioxide. The latter in turn may contribute to the greenhouse effect which is warming the earth, which can lead to changing climatic and agricultural patterns, and may contribute to the

melting of the polar ice caps and the subsequent rise of ocean levels. This last point is a highly controversial one, but if accepted, it indicates the probable flooding of many seaport cities around the world. So, an initial good measure may set off a chain reaction of bad effects.

But the linkages between happenings which may have ultimate negative effects, can be even more direct. This is because as technologies are elaborated and enlarged to meet the economics of scale, a small mishap at one point can bring down the total network or system. It has been noted that while small scale failure can be produced very rapidly, large scale ones can be generated only if large amounts of time and resources are involved. For example, there have always been electric power system failures; in fact, outages occur on a small scale almost every day even in developed societies. They are recognized as such, and coped with as normal emergencies by the public utilities. But not only can something in a far distant place have local effects, but the elaborate linkages almost insure that eventually there will be large scale effects as in the widespread blackout in 1965 which occurred in southern Canada and the northwest United Sates, and in France in 1978.

Massive glitches that impair telephone systems are also becoming increasingly common in many societies. In 1984, such a system outage in Tokyo, Japan affected 89,000 subscribers and cost at least $300 million dollars. In 1991, eleven major phone system outages affecting major metropolitan areas occurred just in the United States alone. In the report accompanying those figures it is noted:

> modern fiber optics carry 10,000 time more calls than the old copper cables they replace. An accidental cut of a single fiber optics can cut off entire metropolitan areas (Lee, 1992: 8).

Perhaps many of the potential problems are summarized in a statement by an expert on telecommunications networks (see McDonald, 1989). He stated that the public switched networks are becoming more vulnerable to disruption because of the introduction of new technologies. Because of economic incentives to cut the costs of normal commercial operations, networks being developed are being designed without sufficient attention to emergency preparedness. Accidents and disasters threaten networks of tomorrow with more extensive damage than they did yesterday's integrated network. The societies of the 21st Century, whether in developed or developing systems, will increasingly rely on smoothly functioning communication networks, so consequences of network failure will be more severe.

As an example we might cite figures from a recent incident in Hinsdale, Illinois where a fire disabled a major Bell Telephone switching center in the Chicago area. This telephone outage as a result of its links to computers affected both voice and data communications for more than a half million residents and business customers in six metropolitan suburbs for periods ranging between two days to three weeks. In addition, local and long distance communications for both telephone and computer networks were also severely affected since the Hinsdale center affected was an aggregation point for major telecommunications links. The outage:

> affected the normal operations of dozens of banks, hundreds of restaurants dependent on reservations, three large catalogue sales companies headquartered in the Chicago area, about 150 travel agencies, most of the paging systems and cellular telephones in the affected area, and hundreds of businesses located in the area or others not located in the affected area but conducting business with those that were...At present, a conservative estimate for the business losses and the repair costs of the accident are set at $200-300 million (Pauchant, Mitroff, Weldon and Ventolo, 1990: 244).

3. **New versions have developed of old or past dangers.**

Certain dangers that take particular forms have been around for centuries. But in the modern world, new versions of the risks involved have taken new forms especially as large scale cities have come into being. Inevitably these kinds of communities require elaborate lifeline systems that literally are the physical or mechanical infrastructures on which they rest. For a small village, a well or two can provide the necessary water; for metropolitan areas, distant reservoirs, dams, pumping stations, pipelines and gauges, monitoring points, etc. linked together in complicated ways are needed to generate and distribute the water. This can create new versions of old or past dangers.

For instance, increasing chronic water shortages are affecting many societies, including developing ones. This is partly related to the great need for water to support the process of industrialization. A recent report of the Worldwatch Institute noted that besides parts of the western United States:

> Many areas could enter a period of chronic shortage during the 90s, including northern China, virtually all of northern Africa, pockets of India, Mexico, much of the Middle East...Where scarcities loom, cities an farms

> are beginning to compete for available water (Postel, 1989:1)

Droughts used to be mostly a rural problem. This is no longer the case. Increasingly in different parts of the world, urbanized localities are finding themselves faced with shortages or reduced water supplies. In the future there will be a disaster if a major section or all of an urban area runs out of water or has enough only for the most necessary of water needs. This is most likely to occur in combination with the collapse of a major tunnel, pumping station or other critical facilities of a water supply system.

This last probability is escalating because of a deteriorating physical and public works infrastructure of lifeline systems in a large number of older cities. The prevalence of decaying bridge and tunnel structures, crumbling highways, obsolete and overloaded waste water and sewerage treatment plants, worn out sewer and water mains, aging subway systems and pipelines initially put in place for an expanding industrial sector, suggest a variety of many potential disastrous possibilities beyond the isolated and occasional accidents of the past. The flood which hit the downtown area of Chicago in 1992 as a result of the collapse of a 100 year old underground freight tunnel is a case in point. It resulted in a major electric power cutoff and a shutdown of the Board of Trade with a resulting loss of 25 billion of dollars in trading, and necessitated the evacuation of department stores and hotels and disrupted businesses for weeks.

Put another way, these problems are starting to appear because much of the physical infrastructure involved is reaching the end of its normal lifetime. One can project that this also will become a problem for urban areas in developing countries compounded by the fact that there is reason to believe there is even less maintenance on the urban lifelines in them than exist in developed societies. This perhaps is illustrated by the recent major failure of a pipeline in Russia, as well as the explosion of a natural gas pipeline in Gahri Ohoda, Pakistan in 1984 which killed 60 people, and the one at the edge of Mexico City in the same year which probably resulted in several thousand dead.

None of the actual or potential disasters likely to occur from these factors are totally new, at least in the geophysical or physical sense, but they represent new versions of old threats, either because of where they could occur or the large scale nature which they can assume.

4. **There is the emergence of new kinds of technological accidents and mishaps that can and will lead to disasters.**

a. Developments in computer technology.

A major new threat that is developing is associated with all the disastrous consequences that will come from the computer revolution that human society is presently undergoing. Use of computers undoubtedly have improved disaster planning and managing, as well making life easier for most of us in many ways. But our increasing dependence on computer technology will magnify future disasters and turn some minor emergencies into major crises. This is particularly true in that many sectors of government and business are increasingly computer based for the data and information they need to function, sometimes literally from minute to minute. Thus:

> It is presently estimated that more than 85% of the largest firms in the US are totally or heavily dependent on computer technology and that, on average, a business would lose 25% of its daily revenue after the sixth day of its system breakdown, while this figure is close to 40% for the financial, banking and public utility industries (Pauchant, Mitroff, Weldon and Ventolo, 1990: 254)

These figures are for America but it is probable comparable figures could be found for countries in Western Europe as well as Canada.

Now it can be predicted with certainty that computer systems and their networks will, for various reasons, cease to function, or function incorrectly (and we leave aside deliberate sabotage by the use of computer viruses). We will then have a really **new** kind of disaster--a computer disaster, with all kinds of negative chain reactions of an economic and social nature. The Hinsdale occasion we discussed earlier is but a simple example of the complex disasters that may stem from partial failures of computer networks.

b. Biotechnological advances.

There are also going to be disasters that will be produced by biotechnology, especially genetic engineering. Basically, this technology involves altering the blueprint of living organisms--plant, animal or human--and creating new characteristics, some of which are very useful (e.g., various kinds of oil and chemical waste eating bacteria have been created that can be used to help clean up spills!). However, there clearly are all kinds of potential disaster possibilities with this kind of technology. There can be and will be the creation of, or the escape from control of, some altered organism that cannot be checked by present known means. Our ability to custom design living organisms almost insures that one day there will be some almost Frankenstein-like bacteria, plant or animal let loose on the world.

Of course there are constant and continuing statements about the safety of the whole process. Thus, a National Science Foundation reported stated:

> There is a broad consensus among biologists that R-DNA techniques are safe...basic and applied scientists generally agree that many contemplated introductions are either virtually risk free or have risk-to-benefit ratios well within acceptable bounds...no hazard particular to genetic engineering has yet surfaced (quoted in Schmeck, 1987: 7).

The term R-DNA is the scientific shorthand label for recombinant DNA, the technical name for the process of rearranging genetic material-DNA-or combining genes from diverse sources.

But as was written in a letter that same year:

> The advocates of recombinant DNA technology claim that it is safe because they cannot see how a disaster would occur and because no disaster has ever happened yet. That amounts to saying that the technology is as safe as the Titanic, the Chernobyl nuclear reactor or the space shuttle (Letter of Robert J. Yaes in 1987, The New York Times).

Assertions of absolute safety of course reminds some of the statement issued by the Atomic Industrial Forum just a few months before the Three Mile Island nuclear plant accident, namely:

> Nuclear power plants are designed and built to withstand every conceivable Acts of God--and some inconceivable ones as well (quoted in Chronicle of Higher Education, 4/1/79, p. 20.

We feel as confident in making the assertion that biotechnology will similarly bring us a major disaster sooner or later. In fact, just as the 1970s was the time when the world became aware of nuclear power threats, the 1980s of the chemical hazards risks, the decade of the 1990s could very well be when we will have a Chernobyl or Bhopal-scale like biotechnological disaster.

Actually a forerunner of what could occur in the biotechnological area is suggested by a related although slightly different kind of disaster in 1979. In that instance, biological toxins were accidentally released at a Soviet research center. Probably 1,000 workers were killed and a 20-square mile area around the city of Svardlovsk was contaminated by the release of highly toxic anthrax spores. To the extent that any country anywhere in the world sets up facilities for biotechnological purposes, it will create some

risks in the production, storage, transportation, distribution and use of the products involved.

5. **There will be an increase in multiple or synergistic type disasters resulting in more severe impact consequences.**

There has been very little recognition given to the fact that natural disaster agents will increasingly generate or magnify concurrent technological disasters (and even possibly in the other direction). Increasingly so, because of the accelerated production, transportation and storage of hazardous substances of all kinds, natural disaster agents which in the past would have simply been natural disasters can now create technological disasters. For instance, a flood could inundate a chemical plant complex. The convergence of a tornado and a radiologically active cloud could pose a very threatening situation. As an example, in 1961, windstorms spreading radioactive material (plutonium and strontium) in the Lake Karachay region in the Southern Urals increased by about 30 to 50% the land area previously contaminated by an earlier nuclear disaster in Russia. The earlier technological disaster was magnified by a later natural disaster agent (Porfiriev, 1992).

Not often noticed is that at least hypothetically is that this process could also go in the other direction. For example, an MIT study recently suggested that continuing pollution may result in stronger hurricanes. Continued air pollution that increase carbon dioxide levels, according to this research, could make some hurricanes up to 60% stronger in the next century. This last example suggests that not only are disaster agents and occasions increasing, but that because of human and group behavior, there will be an enlargement of social risks and vulnerabilities in the future, a matter to which we now turn.

Enlargement of Social Risks and Vulnerabilities

Parallel to the increase or negative changes in disaster agents, are certain transformation in the populations and communities which can be impacted. The end result of these social trends, mostly stemming from the urbanization process, is an enlargement of social risks and vulnerabilities, especially for modern societies. Thus, even if there had been absolutely no change at all in agents or occasions, we could still expect more and worse disasters just from the changes that have and are occurring in the individuals and groups, that are potential candidates for impact in the future.

1. **Both natural and technological disaster agents will simply have more to hit and along some lines will have greater impact.**

It is easy to overlook that natural disasters have consequences only in a social context. Now such physical agents are probably not increasing per se (at least on any observable human time

scale), although some like hurricanes can fluctuate considerably over time. However, what any physical agent can socially impact has and is changing.

Many different regions of many countries are being subjected to unprecedented population growth, building of structures, and economic development. For a variety of social reasons, many areas are being built up. This means that more than ever before there are greater number of people and greater amount of property vulnerable to the risks of different disaster agents. For example, there are more people and settlements than ever before in riverine flood plains. Because of social factors, where in the past there was marsh or swampy areas, there are now housing complexes and industrial parks. The same picture could be drawn for earthquakes, tornadoes, and volcanic eruptions (and of course the same is true for technological agents). There is simply more of a built environment they can impact. Where empty or very sparsely populated space might have been hit in the past, in the future many people and their build environments will be hit. The property destruction wrought by Hurricane Andrew earlier this year in Florida would have been considerably less just a decade ago because there was much less of a built environment to impact.

There is practically nothing of the reverse process, that is, abandonment or withdrawal of human activity from dangerous areas. A way to document the probable greater future impact is to ask the following: if the last major disaster to hit an area were to hit exactly in the same way now or in the future, would there be more or less of an impact? We think almost all would say more.

Additionally, there will not only be more impact from the commingling of both natural and technological disasters, but the quality of the impact in some cases could be worse. For instance, in the United States, Canada and most of Western Europe (except in Italy), there have been only a handful of disasters in recent times where more than 1,000 persons have died. But some of the future possible disasters could create dead victims well in the high four or even five figures. Even handling relatively few dead bodies in most modern societies generates all kinds of problems from logistic ones of finding enough caskets to psychological ones of coping with dead bodies. Future disasters with numerous dead bodies will sharply increase those kinds of problems.

We can not only be certain of the happenings of certain kinds of technological disasters, but they too can result in qualitatively worse results than certain other kinds of disaster impacts. For example, chemical poisonings and radiation contaminations often require complex, sophisticated and labor intensive kinds of medical treatment. They can and do put much more of a strain on emergency medical services than the "ordinary" disaster. Often in these kinds of disasters, material things, equipment, land, can be polluted and contaminated in ways different than the usual. The

cleanup is often far more costly and requires more specialized knowledge than is usually the case, say after floods or earthquakes. Also, in some instances, there are second order effects; for example, health consequences can surface years later, a major concern in Russia and the Ukraine following Chernobyl.

2. **More vulnerable kinds of population will be impacted than in the past.**

Populations in future disasters, because of social changes--some of lifestyle, others of a demographic nature--will be more vulnerable to negative effects.

Changes in lifestyles can increase vulnerabilities to disasters. For example, notions of leisure times and vacations are very widespread in developed societies. This in turn leads to the creation of certain kinds of resort areas which are particularly vulnerable. Such changes in lifestyles are leading more people to be tourists in resort areas at risk from such happenings (a similar pattern is true in Europe with respect to avalanches in ski resort villages). Also, increasingly families are building second or vacation homes in wildlands that are rather vulnerable to brush fires. This is in addition to the encroachment of homeowners whether in the French Riviera or California on land which used to be much more sparsely populated in the past. In the latter locality, the Oakland Hills fire of 1991 resulted in 25 dead, nearly 3,000 homes damaged and more than a billion and half dollars of property losses.

Then there are other even more fundamental changes in family patterns; the form of the family has been changing. For example, more and more, the traditional type of the family known as the nuclear one, a husband and wife with children, is less and less the dominant form. Households are increasingly made up of members that consist of single people, childless couples, both male and female single parents, unmarried same or different couples such as heterosexual partners and gay couples, as well as unrelated roommates. Much disaster planning implicitly assumes that most households will be made up of nuclear families. But this is a diminishing social pattern. Furthermore, the other types of growing kinds of households all present different kinds of issues and problems for disaster planning and managing (e.g., the homeless presented unexpected major relief problems in the Loma Prieta earthquake and the Hurricane Hugo disasters in the United States).

Then there have been and are changes occurring in the demographic characteristics of populations in modern societies. These can result in qualitative changes in vulnerability. As an example we are increasingly getting an older population in at least the majority of developed countries around the world such as France and Japan. For various reasons older persons tend to live in areas which are more subject to risks such as the state of Florida in the

United States. But irrespective of where they live, it is known that older people among other things are proportionately more likely to be injured in disasters. In addition, older victims find it more difficult to make up for property losses; in fact, the elder have proportionately more to lose. In developing countries, the problem is just the reverse since they have very young populations. But along with the elderly it is also the very young who are more likely to be casualties in disasters.

There will also be expanding risk for those already at social disadvantage in a community. The poor are the most vulnerable in several ways. They generally live in more dangerous locations such as flood plains or around chemical plants. Also, the poor at risk are less able to cope with the losses to be expected in disasters. The problem is compounded by the fact that certain of these populations in urban areas are particularly heterogeneous, which we will now discuss.

3.**Increasingly metropolitan areas will be impacted: along certain social lines, they are not well suited for coping with disasters.**

For a variety of reasons, some of which have already been indicated, cities and metropolitan areas will be increasingly subjected to disasters. In general, the social characteristics of such localities will tend to increase the difficulties in many kinds of crises because of the highly bureaucratic nature of urban organizations, and the heterogeneous sociocultural patterns of urban groupings. Since both make planning for and managing disasters more difficult, the more there are disasters in urban areas, the more there will be problems.

a. Urban bureaucracies.

It is necessary to avoid sterotypic and negative notions of bureaucracies when discussing such types of social organizations. It is nevertheless true that bureaucracies are not the most adaptive social organizations for coping with fluid and ambiguous occasions, among the very hallmark of the emergency periods of crises. Disasters involve nonroutine occasions. In those kinds of situations, as disaster studies have consistently found, new or emergent rather than traditional or standard behavior patterns are more adaptive for the demands or problems that surface. For example, hospitals and the hospital system can better provide emergency medical services if the bureaucratic authority structure, the traditional decision making process, and even the traditional division of labor, are not completely followed (Quarantelli, 1983).

When faced with survival or serious loss threatening catastrophic events, organizations are often advised to adopt radical or frame-breaking changes. However, research indicates that threatened organizations are inclined to do exactly the reverse: they tend to be rigid and detached, relying heavily on existing strategies,

routines and resources to pull them through such occasions. Put another way, since bureaucracies are not the best social organizations to prepare for and respond to disasters, their presence in the midst of such crises, can only magnify the problems that will appear.

b. Heterogeneous subcultures.

It is widely believed that many segments of urban populations live in very disorganized and anomic social settings. This is not correct. This perception usually reflects the view of dominant and majority groups when they look at the non-mainstream social groupings that increasingly live in urban areas. But far from disorganization and anomie, what is present are different social worlds and subcultures whose members have different values and beliefs than the dominant social pattern and culture, most stemming from different ethnic and/or religious backgrounds. Many of the metropolitan areas in developed countries be it Germany or France, have been the end point of migration from developing countries (and in developing countries the cities too are the magnets for rural migrants). A major consequence is that heterogeneity characterizes their urban way of life.

These kinds of population mix can affect disaster response in a variety of ways, make disaster planning even more complicated than usual, and generally raise the risks and vulnerabilities for the persons and groups in the mix. For instance, some ethnic and minority groups see hazards differently from other groups, with some assuming natural hazards can be overcome and others assuming human beings have to accept and adjust to threats. Depending on the belief, this can affect efforts at disaster mitigation or prevention. People from different cultures can also vary in their support for protective actions, with some taking a somewhat fatalistic and resigned position because of certain kinds of religious values. Adoption of emergency preparedness measures can be affected by this. Also, some groups have very extended kinship systems which can provide considerable support at times of crises; conversely, other disaster victims because they trust no one other than their own, may have few or none to turn to for social support. As another example we may note that studies show minorities often have the most problems recovering from disasters because they frequently are not that socially visible to those providing help.

Our point is that any kind of sociocultural mix along any of the lines indicated will complicate and generally make less efficient and effective any aspect of disaster planning or managing. A relatively homogeneous population is much easier to plan for and will have less risks and vulnerabilities in disasters.

4. Increasingly, localities will have disastrous conditions from disaster sources that may be quite distant.

An interesting pattern for some disasters of the future is that their source and their point of impact may be quite distant from one another. Sometime impact is within a limited geographic area, although threatening localities away from the original risk source. For example, a chlorine gas cloud in Florida drifted about 28 miles from where a train accident occurred; if the same derailment had occurred in a metropolitan area rail yard, millions of people would have been put at risk. As another example, a 1980 pollution episode of the Po River in Italy extended over a 60 mile stretch.

But more important are when hazardous effects go over important jurisdictional boundaries. sometime of nation-states. For example, the 540 mile Meuse River arrives in Maastricht, The Netherlands loaded with human sewage and chemical waste picked up earlier upstream in France and Belgium. As is well known, the radiation fallout from Chernobyl fell in various parts of the world, but especially in certain European countries. The even more recent example of pollution in the Rhine River which starting near Basel, Switzerland, affected about six different nations and polluted upriver for almost 800 miles, or the Ohio River pollution which had severe consequences for several states are again harbingers of what we might expect more in the future. In fact, West Europeans have recently expressed concern for future risks to themselves, not over their own nuclear plants, but from deteriorating facilities in Eastern Europe, especially the six nuclear plants in Bulgaria which produce about 40 percent of the country's electricity.

Consequences at a distance are not confined to technological type disasters. A Japanese bank recently analyzed the effects on the world economy if a major earthquake impacted Tokyo. It projected that because of the central role of Japan in the internationalized financial markets, the economic after shock would be felt around the world. It noted that in 1987, some 18.7% of the about two billion in foreign money which flowed from abroad into US securities came from Japan. The report also estimated that if the earthquake had occurred in 1988, world economic growth would have been curtailed by 0.3 percentage points in 1989; by 0.9 percentage points in 1990; by 1.5 points in 1991; by 2.1 points in 1992; by 2.4 points in 1993 and by 2.6 points in 1994 (Japanese, 1989:1).

Additionally, certain kinds of technological type disasters can reach far away in both time and space. This occurred in a PBB pesticide poisoning in Michigan in the 1970s which worked its way into the second generation, the children of the original victims later living thousands of miles away from the original pollution source. We might especially anticipate the more slowly moving and diffuse kinds of disaster threats to cut across such space and time dimensions, and we can expect them to increase in the future.

5. **Certain of the future disasters have catastrophic potential even if they would occasion no casualties nor have physical impact.**

Some disasters in terms of their direct effects would be primarily economically costly. It has been noted, for instance, that early discussions of disasters equated the magnitude of impact to the number of people killed or injured, or to the amount of property damaged. Unfortunately, things are not this simple. The accident at Three Mile Island (TMI) provided a dramatic demonstration that factors besides injury, death, and property damage impose serious costs. Although there was not a single death at TMI and few if any latent cancer fatalities are expected, as Slovic has written:

> no other accident..has produced such costly societal impacts. The accident...certainly devastated the utility that owned and operated the plant. It also imposed enormous costs (estimated at 500 billion dollars...) on the nuclear industry and on society (1987: 282).

It did this through stricter regulations and the reduced operation of reactors worldwide, greater public opposition to nuclear power and greater reliance on more expensive energy sources, and increased costs of reactor construction and operation.

As a variant of this, we may note that some future disasters will be very socially disruptive, less because of their direct physical effects, but from consequences because of the way they will be perceived. A good example of this occurred in Brazil in 1987. A cancer treatment machine abandoned in a junkyard released some dangerous cesium 137 which through radiation contamination killed about four people and seriously affected about 44 others.

But far more consequential was the perceived risk to <u>and</u> from anyone that initially resided in the affected locality, namely Goiania, Brazil. The occasion is almost a classic case of the potential negative impacts of perceived risk. Over 100,000 residents out of a total population of about one million in the area underwent Geiger counter examinations to detect possible contamination; it was reported that about 8,000 formal certificates were issued to counter the effects of being stigmatized as a hazardous carrier of radiation. This was not an unreasonable coping effort since the anxiety over potential contamination led hotels elsewhere in the country to cancel reservations of persons from Goiania, buses and airplanes to refuse to take Ghanaians as passengers, and some doctors and dentists to take new patients who did not have the certificates. There was also cancellations of scheduled conventions in Goiania. One estimate was that regional tourism fell over 40% and it was reported that property values fell, with sales levels for the entire city and state being affected. Possible as much as 50% of the state's export sales were lost during one month with the area's agricultural products being

boycotted (or purchased at 50% of value). Even textiles and clothing manufactured in Goiania were affected--some losing nearly 40% of their value.

Clearly these kinds of future disasters resulting mostly in non-physical but massive social, economic and/or psychological disruptions will have to be planned for in the future. There will be a need to get away from equating disasters only with fatalities, a rather narrow and almost completely discarded notion in most of the social science research literature.

The Future of Disaster Planning

So far we have projected a picture of the future that by most criteria would be viewed as negative. But that is neither our intent nor is it a fully accurate projection if left at that. The future with respect to disaster planning is not completely bleak. Some of the social changes that are occurring will also positively affect disaster planning in the decades to come. In particular, we want to note some of the implications in the ever increasing importance of the mass media in social life and in the trend towards democratization of political activities. They both encourage and facilitate improvements in disaster planning.

The mass communication systems around the world, particularly as the result of accelerating developments in electronic and computer technologies, have greatly increased their capabilities to quickly produce and distribute information of all kinds. There are numerous and fundamental consequences from this for practically every aspect of human life. However, for our purposes, we want to solely note some of the implications for the disaster area.

For example, the mass media outlets increasingly put disasters on the agenda of everyone they reach. The information put forth about disasters is simultaneously exposed to mass audiences in far distant places. Thus, a hurricane in Florida in the United States will be noted as happening and significant not only by the American population, but also by many in Dacca in Bangladesh, an area also subject to major cyclonic disasters. An earthquake in Armenia will not only be visually exposed to those in that region in the former Soviet Union, but will equally be brought to the attention of audiences in Mexico City, another earthquake prone area.

But it need not even be a disaster experienced in a given area. For example, we happened to be on the ground in Abu Dhabi in the Arabian Peninsula when the Challenger space shuttle explosion occurred--it totally dominated that day all of the news stories in the mass media of that country. In a somewhat similar fashion, a Bhopal in India or a Chernobyl in Russia becomes, as a result of media outlet exposure, instantly memorialized all around the world as an important historical happening as well as a symbolic representation of disasters that threaten the human race (see

Wilkins, 1987) as do in slightly different ways famines as the current one in Somalia or earlier in Ethiopia.

This kind of exposure to the content of mass communication systems, particularly since much of it is depicted in very dramatic visual ways, can contribute to the notion that there should be planning for disasters. Massive or image creating disasters in particular (such as a Chernobyl or a Bhopal) tend to generate efforts at planning for such crises. Even though distant from themselves, officials and communities elsewhere are given striking examples they can use to argue for more local disaster preparedness.

There is every reason to think that in the future mass communication systems will increasingly report on major disasters that are distant from their own areas. Modern technologies have enhanced the abilities of local electronic mass media stations to send their own personnel to report directly on disasters. For example, most television stations in many metropolitan areas in the Eastern United States sent their own reporting teams to send report back--often live--of the Loma Prieta earthquake (and there were also media representatives on the scene in California from Japan and Western Europe).

This kind of mass media information dispersal supports already existing tendencies to improve disaster planning. We should note that we are not talking of a static social setting insofar as such planning is concerned. In fact, looking at the historical evolution from the past to the present, one might be encouraged in terms of dealing with future disastrous occasions. The present situation is certainly better than what existed in the past.

Our center, the Disaster Research Center, has done considerable research for nearly 30 years on preparations for and responses to natural and technological disasters. Along some line our recent field studies report rather good news. For example, local emergency management agencies in the United States, have much better disaster planning and managing and have better personnel than they once had. Across the country, their preparedness as a whole has markedly improved over the last 15 years or so (see Wenger, Quarantelli, and Dynes, 1986).

A similar picture can be found if one looks at most countries, developed or developing, around the world. In the last few decades planning for and responding to disasters has improved. There has been a particular acceleration of the process in European countries such as Italy, Great Britain, Greece and Spain. Where nothing once existed, much has been created; where there was something in place it has been made better. Almost anywhere that one looks the present as compared with the past is an improvement. Even in developing countries, except perhaps in Sub-Saharan Africa, there has been notable increases in disaster planning in such societies as India, Mexico, China, Venezuela and Bangladesh.

There is no reason to think that the indicated improvements will not continue to occur. Disasters will increasingly be on the agenda for attention as the mass communication systems everywhere will find it progressively easier to report on such news stories. While we would not want to suggest that such information dispersal is completely socially functional (a topic which deserves a full treatment which can not be given in this paper), without doubt the news stories will contribute positively to existing efforts to improve planning for disasters.

In turn, the input of mass media content about disasters has and will continue to converge with another major social trend. As a whole, a major social change going on has been a move towards democratization of political activities. This involves changes of many different values, beliefs, activities and practices. For the purposes of this paper, two of the more important have to do with what citizens increasingly expect of their governments and the rise of citizen activism. Both of these have moved and will continue to move in the direction that citizens increasingly expect their own governments to protect them against disasters and/or join with their fellow citizens in informal efforts towards better planning for environmental threats.

For centuries in many places, the populations had little expectation that their governments could or would do much to protect them again the impact of disasters. Partly as a result of religious beliefs as well as a general fatalistic attitude about the vicissitudes of life, "Acts of God" were accepted as inevitable.

But this has changed. Partly as a result of the secularization that has progressively become the dominant mode of thinking in Western thought and also because of certain changes in political beliefs about the role of governments, "fatalism about disasters" has become less and less an acceptable popular view. Especially in the developed countries, but spreading rapidly elsewhere:

> most citizens accept disaster planning as an appropriate and acceptable function of government...[and] is viewed as a public responsibility (Drabek, 1986: 23).

In fact this author notes that there has been:

> some fundamental changes in hazard perceptions. God is losing ground, when it comes to flooding, for example. And if not God, than man.

> While events per se may still be viewed as "Acts of God," it is my belief that greater segments of the public view certain types of damages as avoidable, if government will act (1986: 342, 352).

As other writers have noted:

> As humans have come to understand and control natural processes, disasters which were previously viewed as "natural" in that they were beyond human control, are now seen by many as environmental events which can and should be managed.
>
> Currently, many "natural" disasters are not perceived as clearly natural or technological in origin...We suspect that humans will increasingly come to view natural disasters as "unnatural" in origin: people will increasingly assume that humans, and human created systems, are at fault (Blocker, Rochford and Sherkat, 1991: 378, 379-380).

Of course the advent of technological disasters is accelerating the acceptance of this view because to many such dangers are seen as inherently more capable of being controlled by human beings.

That the latter is the case is additionally supported by the emergence in many places of citizen groups interested in environmental threats mostly of a technological nature (such as hazardous wastes, radioactive materials, chemical substances, etc.) From a reactive stance towards the happening of natural disasters, many in this movement have moved to a proactive stance with respect to technological disasters. Thus, both in Europe and the United States, numerous small groups of citizens, usually in an informal way, have formed to better prepare for and respond to chemical and nuclear related hazards which might turn into disasters (see Quarantelli, 1985). There is every reason to think that such large scale citizen activism will if anything increase in the sense of an increase in both the number of such groups and the range of risks about which they think something should be done.

Overall then, social trends such as greater expectation by citizens that they should be protected against environmental threats as well as particular happenings such as the UN Decade for Natural Disaster Reduction, assure that in almost all societies we can anticipate continuing if not increased attention to disaster planning.

Nevertheless, it is rather clear that on balance matters are going to get further unbalanced. We are going to be faced with more and worse disasters in the future no matter how much disaster

preparedness and personnel have or could improve in any realistic sense. If we look not from the past to the present, but from the present to the future, that is the inevitable outcome. Such changes as will occur in disaster planning while in the right direction will not be able to match the quantitative and qualitative increases in disasters if the present level of effort is not increased.

In many ways this is no different from what has been observed of the more general environmental problems that face the world.

> The various environmental crises that the world is facing--exhaustion of resources, spoilage, toxicity, and pollution--will grow worse before they grow better. The logic behind this assertion is that the impulse among nations to develop economically and compete with others is so strong that they will give greater priority than impulses to protect the environment. In the short run, environmental considerations constitute a cost and a liability in the drive toward competitive productivity. This effect will no doubt be stronger in those nations struggling to catch up--the former Eastern bloc and the Third World countries--than in the developed nations with developed environmental movements (Smelser, 1991).

Nevertheless, this does not mean nothing can be done. A major first step is to understand the source of the problem for that will also tell us something on what needs to be done. Let us note one general implication of research based observations. It is that solutions are not to be found primarily in new technologies or better use of existing ones. The character of future disasters will primarily stem from social factors. Social problems can only be dealt with socially; improvements in technology can only address technological problems. This is not an argument against the use of technology or its improvement, only that if something is socially problematical, social solutions must be sought.

It certainly should be clear from our remarks that the more and worse disasters of the future can be primarily attributed to changes or trends in human or social factors rather than in meteorological, geophysical or technological happenings per se. Thus, the greater vulnerability of the aged to future disasters in developed countries is partly attributable to the fact that, for example, in the United States retired people increasingly tend to live in mobile or trailer home parks in flood plains and flash flood areas. Likewise, the increasing risk of populations in developing countries to earthquakes, typhoons, and landslides is equally partly attributable to the large number of homeless and

very poor rural migrants flocking to and residing in more hazardous zones of metropolitan complexes such as Lima, Calcutta, Hong Kong, Lagos, Cairo, and Rio de Janeiro. A possible solution in both cases is the institution of more appropriate land use management.

Finally, there is a need to be realistic about what can or cannot be achieved. There are limits. A risk free society is a chimerical dream. As someone has said, if the production of mushrooms were invented today, there would be those that would urge their total prohibition. The notions that hazards and subsequent disasters can be completely eliminated is not borne out by history. That not everything can be done, does not mean that something can not be done. We can without doubt decrease the increase of future disasters and lessen somewhat the qualitatively worsening of their effects. We should take the necessary steps to do so.

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